UNITED STATES DEPARTMENT OF THE INTERIOR

RAY LYMAN WILBUR, Secretary

BUREAU OF RECLAMATION

ELWOOD MEAD, Commissioner

Reclamation Projects Visited by the Appropriations Committee House of Representatives

Second Trip, 1931

ORCHARDS IN YAKIMA VALLEY, WASHINGTON

OWYHEE STORAGE DAM UNDER CONSTRUCTION ON THE OWYHEE PROJECT, OREGON-IDAHO. THE DAM WILL BE 520 FEET HIGH FROM THE LOWEST PART OF THE FOUNDATION TO THE TOP. (SEE P. 20)

Reclamation Projects Visited on the Second Trip of the Appropriations Committee

This pamphlet has been prepared to aid the Appropriations Committee of Congress and its associates in their studies of Federal reclamation. This trip will include examinations of seven completed projects, seven in process of construction, and six proposed.

Organization of the Bureau of Reclamation

The headquarters of the Bureau of Reclamation are in Washington. The commissioner, Elwood Mead, has, under the secretary, the oversight and administration of all of the work of the bureau, which includes construction of works, administration of the projects, the collection of moneys due the Government and the determination of important legal problems, both in Washington and in the field. P. W. Dent is the assistant commissioner and chief counsel. The administrative staff comprises from 1,500 to 2,000 employees, which does not include contractors and their workmen. The accompanying chart shows the organization as of November 1, 1930.

Engineering and Economic Results

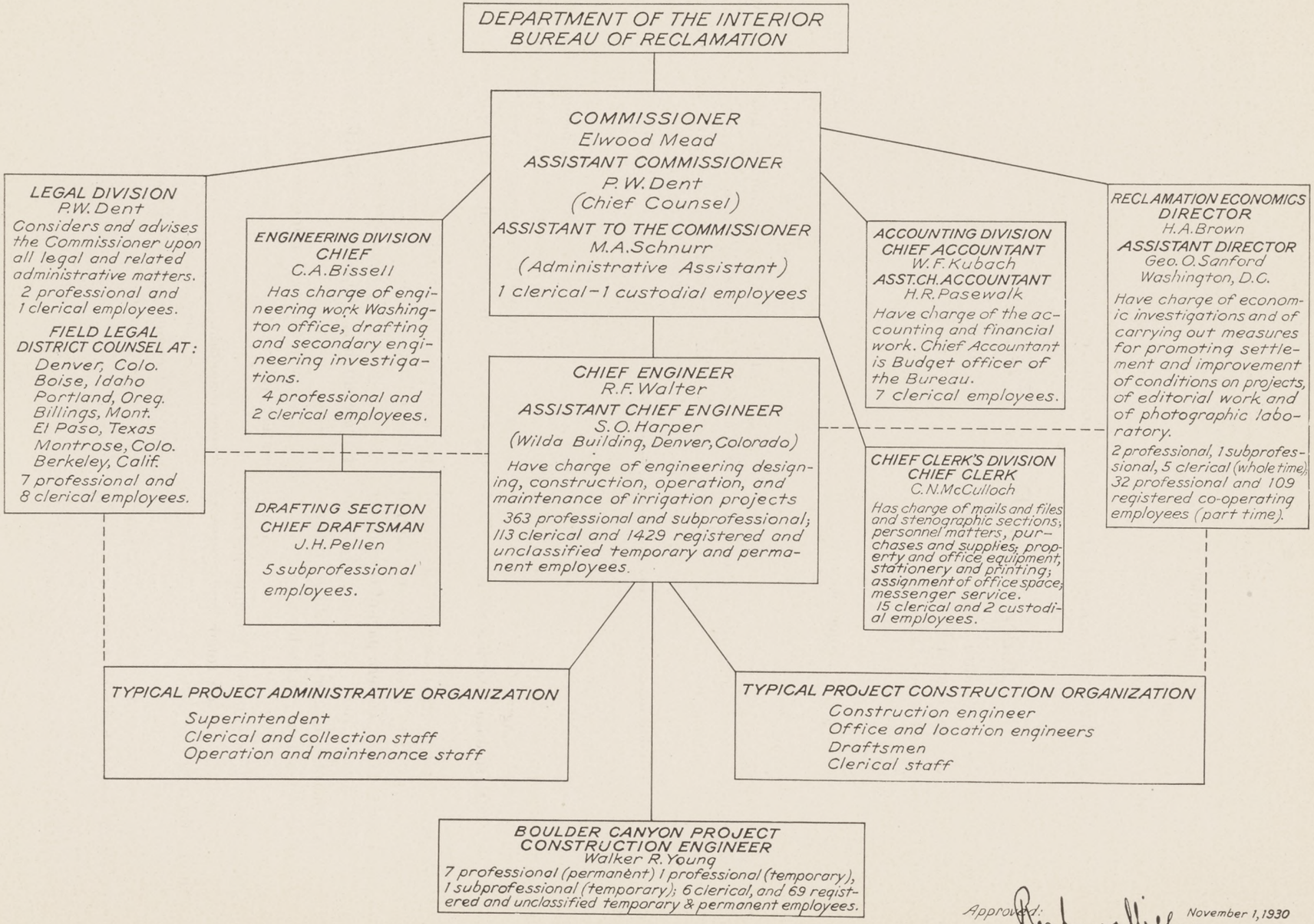
The Bureau of Reclamation is engaged in the investigation, construction, and operation of irrigation works in 15 arid and semiarid States. Twenty-seven projects have been constructed or are under construction by the bureau. Sixteen of these projects or divisions of projects have been turned over to water users' organizations for operation and maintenance.

The area irrigated in 1930 with water from Government works was 2,723,185 acres, of which 1,504,810 are on Government projects, and 1,218,375 are under private canals which purchase stored water from Government reservoirs. The irrigated areas in 1931 are materially larger. In the arid West where these canals have been built, values inhere in water, not in land. Before these works were built nearly all the land was an unpeopled waste used only for grazing. In 1930 the crops grown were worth on an average $43.20 an acre and the grazing land would have been worth nothing without winter feed for stock grown on the irrigated areas. The cumulative value of crops grown on lands irrigated from Government works amounts to $1,760,481,800, which is about seven times the amount which the bureau has expended to date. So far as national wealth is concerned this is clear gain and the improvement in social and economic conditions makes the value of this development infinitely greater.

The limits of irrigation from the natural flow of streams were reached many years ago. The discharge when the snows are melting is many times that when they are gone, and without reservoirs, safe irrigation is restricted to the low water flow of mountain rivers. The chief dependence for water for all works built in recent years is stored water. Storage reservoirs on the projects have a total capacity of approximately 13,000,000 acre-feet, or about 4 acre-feet of stored water for every acre irrigated, yet this is only 40 per cent of the capacity of the reservoir to be created by Hoover Dam. In the 55 storage and 50 diversion dams, completed or now under construction, there have been placed 23,000,000 cubic yards of materials. These include the famous Roosevelt, Elephant Butte, and the 349-foot Arrowrock Dam, for many years the highest in the world. Another notable structure is the Owyhee Dam in eastern Oregon, now under construction, which will be 405 feet in height—the highest dam until the completion of the 730-foot Hoover Dam.

The 13,500 miles of canals, if placed in line, would reach four times across the country from New York to San Francisco. The bureau has constructed 249 miles of dikes and levees, containing 7,210,000 cubic yards of material. Approximately 170,000 canal structures, 12,000 bridges and 15,000 culverts have been built. The projects also include 1,800 buildings, 125 tunnels,

60052—31——1


DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COMMISSIONER
Elwood Mead
ASSISTANT COMMISSIONER
P.W. Dent
(Chief Counsel)
ASSISTANT TO THE COMMISSIONER
M.A. Schnurr
(Administrative Assistant)
1 clerical - 1 custodial employees
LEGAL DIVISION
P.W. Dent
Considers and advises the Commissioner upon all legal and related administrative matters.
2 professional and 1 clerical employees.
FIELD LEGAL DISTRICT COUNSEL AT:
Denver, Colo.
Boise, Idaho
Portland, Oreg.
Billings, Mont.
El Paso, Texas
Montrose, Colo.
Berkeley, Calif.
7 professional and 8 clerical employees.
ENGINEERING DIVISION
CHIEF
C.A. Bissell
Has charge of engineering work Washington office, drafting and secondary engineering investigations.
4 professional and 2 clerical employees.
DRAFTING SECTION
CHIEF DRAFTSMAN
J.H. Pellen
5 subprofessional employees.
CHIEF ENGINEER
R.F. Walter
ASSISTANT CHIEF ENGINEER
S.O. Harper
(Wilda Building, Denver, Colorado)
Have charge of engineering designing, construction, operation, and maintenance of irrigation projects
363 professional and subprofessional; 113 clerical and 1429 registered and unclassified temporary and permanent employees.
ACCOUNTING DIVISION
CHIEF ACCOUNTANT
W.F. Kubach
ASST. CH. ACCOUNTANT
H.R. Pasewalk
Have charge of the accounting and financial work. Chief Accountant is Budget officer of the Bureau.
7 clerical employees.
CHIEF CLERK'S DIVISION
CHIEF CLERK
C.N. McCulloch
Has charge of mails and files and stenographic sections; personnel matters, purchases and supplies; property and office equipment, stationery and printing; assignment of office space, messenger service.
15 clerical and 2 custodial employees.
RECLAMATION ECONOMICS
DIRECTOR
H.A. Brown
ASSISTANT DIRECTOR
Geo. O. Sanford
Washington, D.C.
Have charge of economic investigations and of carrying out measures for promoting settlement and improvement of conditions on projects, of editorial work and of photographic laboratory.
2 professional, 1 subprofessional, 5 clerical (whole time); 32 professional and 109 registered co-operating employees (part time).
TYPICAL PROJECT ADMINISTRATIVE ORGANIZATION
Superintendent
Clerical and collection staff
Operation and maintenance staff
TYPICAL PROJECT CONSTRUCTION ORGANIZATION
Construction engineer
Office and location engineers
Draftsmen
Clerical staff
BOULDER CANYON PROJECT
CONSTRUCTION ENGINEER
Walker R. Young
7 professional (permanent) 1 professional (temporary), 1 subprofessional (temporary); 6 clerical, and 69 registered and unclassified temporary & permanent employees.

Approved: November 1, 1930

Secretary.

Accession No. 24050

1,400 miles of road, 150 miles of railroad, 4,100 miles of telephone lines, and 3,300 miles of power transmission lines. At the 23 power plants on the projects 190,000 horsepower of electrical energy are developed.

The total excavation to date amounts to 300,000,000 cubic yards, which would make a pile of dirt 1 mile long by 1 mile wide and 300 feet high. Dams and other structures contain 4,500,000 cubic yards of concrete, which required about 5,250,000 barrels of cement. It would take a train over 200 miles long, comprising 26,000 freight cars to transport this amount of cement.

Through the works before enumerated 40,000 irrigated farms have been created. On these, 157,000 people now live. On these Federal irrigated areas are 215 cities and towns with a population of 475,000; 690 churches, 715 schools and 130 banks, with deposits of $145,000,000 and 245,000 depositors. The future growth of the West must depend on water conserved and distributed. Only Federal reclamation can perform this task. Private development has practically ceased.

Lower Platte Project, Nebraska

At the request of the State authorities and congressional representatives, the committee has arranged to inspect what is known as the Lower Platte irrigation project in Nebraska. The party will leave the train at Kearney and traverse the country up the Platte River to North Platte. A report on the project was made in 1923 by F. F. Smith, engineer, Bureau of Reclamation, under contract with the Lower Platte Irrigation Association, from which the following data are taken:

The irrigable lands extend along the Platte River from North Platte to Shelton on the north side, and from Sutherland to Lexington on the south side, embracing a total of 415,000 acres net. This includes 120,000 acres under private canals for which it is proposed to supply storage water only during the low-water months.

The length of the project on the north side is 118 miles, the irrigable area ranging from 1 to 10 miles in width. On the south side the length is 83 miles, ranging from 1 to 4 miles wide.

The project is in the twilight zone between the arid and semiarid regions. The average annual rainfall varies from 18 inches in the western part of the project to 25 inches in the eastern part. The land along the Platte River is generally divided into three classes—river botton land, bench land, and table land. Irrigation is confined mostly to river bottom land. The new areas would include a considerable amount of bench land, the table lands being too rough and costly to reach with gravity irrigation west of Lexington on the south side and the entire length on the north side.

Transportation facilities are excellent, as the main line of the Union Pacific Railroad passes through the center of the irrigable area on the north side for its entire length. The greatest haul from either side of the river to a shipping point is 8 miles, with an average of about 3 miles. Highways throughout the valley are excellent. The principal markets are Omaha, Chicago, and Kansas City.

Lands are in private ownership, the holdings ranging from 40 to 3,000 acres. The majority of the cultivated land has been depleted in the amount of original humus content, owing to continuous grain cropping. About 34,560 acres need drainage.

Between Kearney and North Platte are six irrigation canals diverting from the Platte River. The gross area commanded by these canals is 157,500 acres, of which 22,422 acres, or 14 per cent, are covered by permanent water rights purchased from the canal companies. In order to carry on a proper crop rotation and to enter into a system of diversified farming, water must be available for the crops during the growing season and the flow of the river supplemented by stored water. Cost of storage is estimated at $26.40 per acre-foot. The total estimated construction cost for new lands, 248,000 acres, is $20,450,000, or $82.50 an acre, and for supplemental storage for lands under private ditches, 100,000 acres, $7,150,000, or $71.50 an acre.

A reservoir at Sutherland would provide storage water in the late summer months for land already under development. No new land would be brought under irrigation.

Before adopting actual construction plans, certain additional engineering investigation should be made. This is because of the large area involved and the semi-humid character of the climate, which will make some landowners reluctant to incur the cost of irrigation.

Saratoga Project, Wyoming

The proposed Saratoga project has been investigated by the Bureau of Reclamation and reports have been made on the cost and the probable economic results of irrigating 31,000 acres in the North Platte Valley. It is a project of especial interest to the committee because it provides for the utilization of part of this river in the upper courses of the stream, thereby serving as an equalizer in its flow. The irrigable area is a tract 31 miles long with an extreme width of 5 miles. The irrigation plan includes a low diversion dam at a point where the river valley narrows to a pass through a granite formation known as Baggott Rocks. The irrigable lands lie between 6,500 and 7,000 feet elevation which shortens the growing season. The yearly rainfall is about 12 incles. The main crops will be hay, grain, tame pasture, seed peas, and potatoes, with dairying and stock feeding as related industries. It is estimated that the project lands can pay a maximum yearly assessment of $3 per acre for water. The yearly operation and maintenance is estimated at $1 per acre, leaving $2 per acre for repayment of the construction cost. The estimated cost of the project is $3,249,401, or $105 per acre.

The advantages of the project are—

1. Uniformly good soil.
2. Nearness to a railroad and the Lincoln Highway.
3. Healthful climate and summer recreational facilities.
4. A local market for hay and grain on the adjacent grazing areas. This is the most important economic reason for constructing this project.

The Denver Office

From the Saratoga project the party will motor to Denver, inspecting the Rocky Mountain National Park on the way. Denver will be reached about 11 a. m. on June 26. The engineering office of the Bureau of Reclamation in the new customhouse building will be inspected immediately. This is the engineering headquarters of the bureau. Here the party will see the preparation of plans for the Hoover Dam on the Colorado River, the Madden Dam on the Panama Canal, the Owyhee Dam on the Owyhee River, the Cle Elum Dam on the Yakima River, the diversion dam on the All-American Canal, and plans and photographs of the Kittitas Canal, one of the most difficult pieces of canal construction to be found in any country.

R. F. Walter, chief engineer, is in charge of all the operations carried on at the Denver office. S. O. Harper is assistant chief engineer and is in charge in the absence of the chief engineer. J. L. Savage is the chief designing engineer and L. N. McClellan the chief electrical engineer. In 1930 the organization was expanded by the addition of more than 100 engineers and draftsmen, the entire staff at present averaging about 165.

In accordance with the expressed desire of the President to expedite the starting of Hoover Dam as much as possible in order to relieve unemployment, the work of preparing the plans and specifications was rushed to completion by December 15, 1930, about six months in advance of the date originally planned. The completion of this enormous task within such a short time was made possible through the accumulated experience of the bureau's engineering organization, acquired over a period of nearly 30 years, in the design and construction of many of the largest dams in the world. The plans for Hoover Dam and appurtenant features have been passed upon by two boards of engineers composed of some of the most noted engineers in the United States. The first board, known as the Colorado River Board, consists of Maj. Gen. William L. Sibert, Robert Ridgway, D. W. Mead, Charles P. Berkey, and W. J. Mead. The second, or Hoover Dam Board, consists of W. F. Durand, L. C. Hill, A. J. Wiley, and D. C. Henny. The Colorado River Board has approved the general plans, reserving decision on the detail section of the dam and on the spillways until certain further studies and experiments are made. The Hoover Dam Board has approved the contract designs and specifications and has expressed the opinion that they provide for the construction of a safe and efficient structure. The contract plans and specifications will be supplemented by numerous detail designs which will be worked out during the progress of the work, a procedure which is provided for under the terms of the contract. A third board, known as the concrete board, and comprising William K. Hatt, Raymond E. Davis, Franklin R. McMillan, Herbert T. Gilkay, and P. H. Bates, approved the adequacy of the specifications for concrete materials, their mixing, cooling, and use.

Grand Valley Project, Colorado

A night ride on the Denver & Rio Grande Western from Denver will bring the committee to the two Federal irrigation projects constructed in Colorado, the Grand Valley and the Uncompahgre.

The Grand Valley project comprises an irrigable area of 30,380 acres, occupying a strip of land about 40 miles long and from 2 to 5 miles wide on the northern edge of Grand Valley in Mesa County near the western boundary of Colorado. The average elevation of the project is 4,700 feet above sea level. The mean annual precipitation is 8.3 inches. Water is diverted from the Colorado River by a roller crest dam into a main canal 55 miles long. The principal crops are alfalfa, beans, sugar beets, corn, oats, potatoes, and wheat. Last year the cropped area of 15,099 acres produced crops valued at $472,185. The local towns in the valley and the mining towns in that part of the State furnish a good market for most products. The project enjoys excellent transportation facilities, both rail and highway. A new contract is being negotiated with the Orchard Mesa irrigation district, one of the divisions of the project, by which a previous contract is to be amended so as to permit the district to make payment of construction charges over a period of 40 years instead of 20 and in graduated instalments, the initial payments being comparatively small and gradually increasing in amount as the payment period progresses. This contract also provides for the collection of operation and maintenance charges in advance after 1933, and authorizes the levy of heavier assessments on good land than on the poorer land.

Uncompahgre Project, Colorado

The Uncompahgre project, which the committee will visit by auto from the Grand Valley, comprises 75,655 acres of irrigable land in Montrose and Delta Counties along the Uncompahgre River on the western slope of Colorado. The valley has an average width of about 10 miles. The average annual precipitation is about 10 inches. The water supply is from the natural flow of the Uncompahgre and Gunnison Rivers, diversion from the Gunnison being obtained through the Gunnison Tunnel, 6 miles long. Eight large canal systems bring the water to the land. The principal crops are alfalfa, sugar beets, wheat, potatoes, oats, corn, and apples. Last year the cultivated area of 59,875 acres produced crops valued at $1,606,250. The principal markets are Denver, Omaha, Ogden, and Kansas City for livestock; Delta, one of the project towns, for sugar beets; Denver, Missouri River points, Oklahoma, and Texas for potatoes, onions, and fruit; and local mining camps for vegetables and garden produce. Excellent transportation facilities are available, both rail and highway.

As a result of a conference last year participated in by representatives of the bureau, the State, and the water users, when the difficulties of the project were thoroughly considered, remedial legislation was adopted which provides for deferring delinquent payments, including them with and making them payable as part of the project supplemental construction charge, and for the construction of a drainage system from funds collected as construction charges during the years 1932 to 1937 to be repaid as supplemental construction in annual instalments of $85,000 beginning on December 1, 1962.

The project is in need of additional settlers to put the relatively large area of idle land to work, and active steps are being taken by the water users association and the bureau to stimulate settlement.

Salt Lake Basin Project, Utah

In the 10-year program submitted to Congress by the Secretary of the Interior in 1925, there was included the Salt Lake Basin project, so called because it meant storage of the flood waters of the streams flowing into Salt Lake. This included the Echo Reservoir on Weber River which has been completed and is in operation this year, the proposed Hyrum Reservoir in the Cache Valley on a tributary of Logan River, the Ogden Reservoir to store the flood waters of the Ogden River to irrigate dry lands surrounding the city of Ogden, and the proposed Deer Creek Reservoir on Deer Creek to utilize the flood waters of this stream and the surplus flood waters of Weber River carried over in a canal across the divide between Weber River and Deer Creek.

Several tentative plans have been considered for the Deer Creek development. The one considered most feasible is estimated to cost $8,418,712 and would

COLORADO RIVER ROLLER-CREST DIVERSION DAM, GRAND VALLEY PROJECT, COLORADO. (SEE P. 5)

benefit 42,700 acres, the per acre cost varying from $105 for lands with a partial water supply to $300 for lands requiring a full supply. The lands under the proposed project are held in small tracts and are devoted to the production of fruit and truck crops where the present water supply is sufficient for such cultivation. Practically all the lands would be so cultivated if the water supply were adequate. Power might also be developed at the dam, although, because of the variable head, it could probably be marketed only as dump power at a relatively low price. One possible development is that of bringing water from the reservoir to suburban areas of Salt Lake City, although the cost of such a 40-mile conduit would be high.

Boulder Canyon Project

The southern half of the Colorado River flows through the hottest and driest part of this country, a region where all development, if not the existence of civilized life, depends upon the ability to use its waters in irrigation. The purpose of the Boulder Canyon project is to regulate and conserve the flow of that river so that its entire discharge can be put to use, first, where it is released from the dam in the generation of power; next, in irrigation of land and, finally, in meeting the industrial and domestic water supply needs of cities and towns.

The most striking feature of this development is its size. Nearly every dimension is a superlative. Hoover Dam is not only the highest dam in the world, but is nearly twice as high as any dam built. Its height is 730 feet. The width of its base is 650 feet. If it should be overthrown it would still be the highest dam in the world. Four million four hundred thousand cubic yards of concrete will be required in this construction, which is more than all that has been placed in structures by the Bureau of Reclamation during the last 25 years. The lake created by this dam will be 115 miles long and over 500 feet deep. It will hold 30,500,000 acre-feet of water and is not only the largest artificial reservoir in the world, but is thirteen times the size of the Assuan storage in Egypt and eleven times that of Elephant Butte, hitherto the largest artificial reservoir in any country. It will take the entire discharge of the river for two years to fill the reservoir, so that complete control over the discharge is not only possible during the different months of the year but a close average can be maintained from year to year. The lake will give the opportunity to travel by boat through 100 miles of the Colorado Canyon. The regulated and uniform discharge will improve water transportation from the dam to the head of the All-American Canal near Yuma.

The power house attached to this dam will have machinery capable of generating a million horsepower and there will be 663,000 firm horsepower. The entire power output for the next 50 years has been sold under a contract, in which the water and power department of the city of Los Angeles and the Southern California Edison Co. are the guarantors. The estimated power income during the 50 years of these contracts is $361,000,000.

Part of the stored water will be carried to the City of Los Angeles and adjacent coast cities for domestic and industrial uses. The aqueduct is planned to carry 1,500 second-feet of water, or over 1,000,000 acre-feet a year.

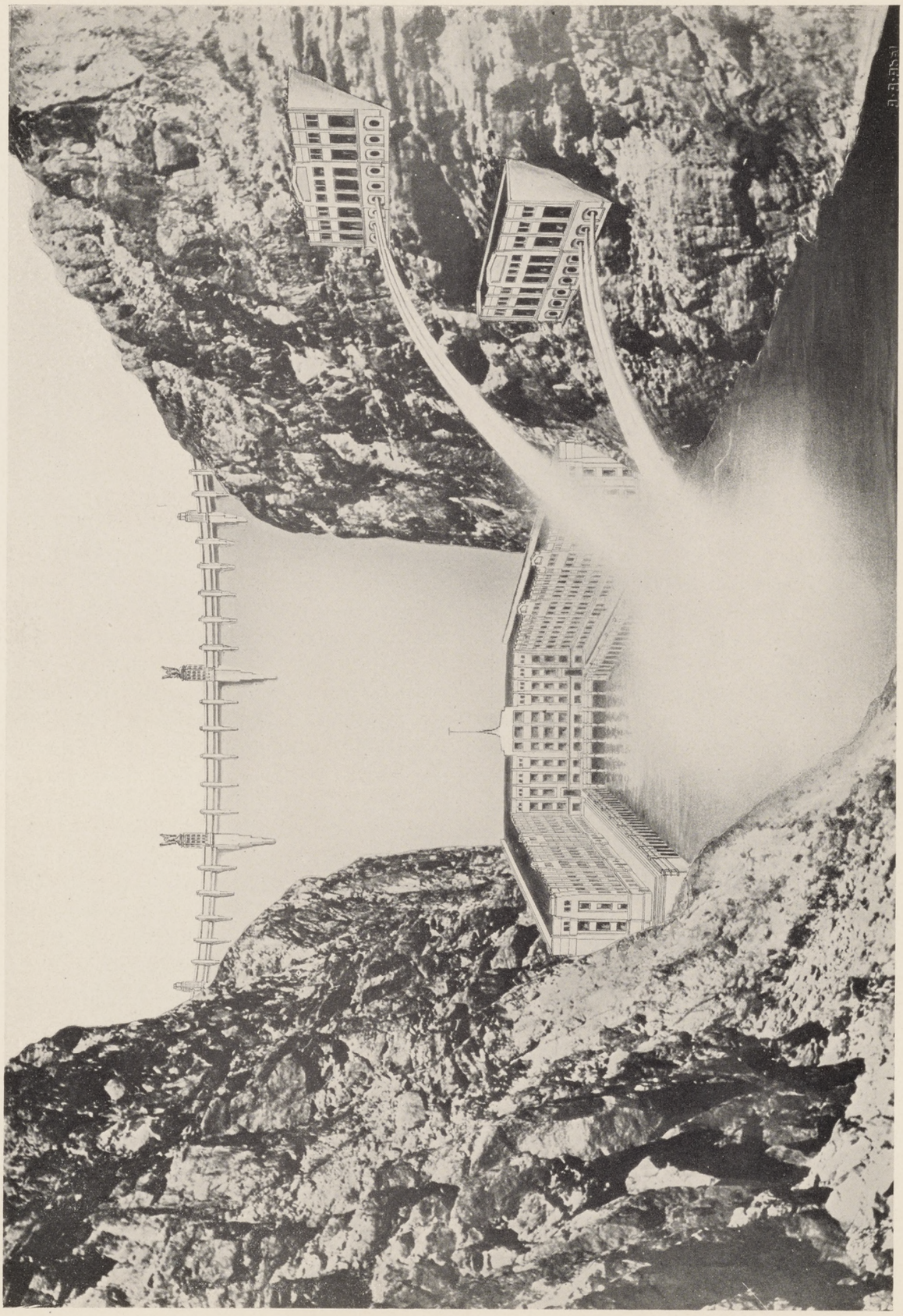
In Arizona the dam will furnish water to enlarge the Yuma project already constructed and in operation and to the Parker Gila project, the survey of which is provided for in the act, and also to the Palo Verde and Chucawalla Valley lands in California. Provision for the irrigation of the Imperial and Coachella Valleys is also made in the act which authorizes the appropriation of $38,500,000 for this purpose. The engineering features of the All-American Canal will be the diversion dam on the Colorado at the head of the canal and the cut through the ridge in places more than 100 feet deep. The irrigated area of the Imperial and Coachella Valleys will include nearly a million acres and is by far the largest irrigation district in this country.

The regulation of this river transforms both the present and future of the southwestern part of this country. Without it, the limits of growth have almost been reached; with it, it is difficult to fix a limit to its population and wealth.

Progress to Date

The initial appropriation of $10,660,000 for the first year's operations on the Boulder Canyon project was made available on July 3, 1930. A further appropriation of $15,000,000 was made on February 14, 1931. The following is a brief summary of the progress made on the various features of this project since that date:

An office was established in the Beckley Building in Las Vegas, which has been used as temporary head-



REPRESENTATION OF THE 730-FOOT HOOVER DAM AND POWER PLANT, BOULDER CANYON PROJECT

quarters for the local engineering and clerical organization of the bureau, but will be discontinued next fall when permanent quarters are available in Boulder City.

A contract was entered into with the Los Angeles & Salt Lake Railroad Co., providing for the construction by the company at its expense, of a 22.7-mile branch line from its main line at Bracken to Boulder City. This branch line is now completed and in operation. This line is constructed in accordance with main-line standards, with 90-pound rails, and ballasted throughout. At the interchange yard at the Boulder City end, 10 tracks have been provided, with a total capacity of 600 cars. Spurs have also been constructed to the contractor's and Government warehouses.

The Southern Sierras Power Co., of Riverside, Calif., was awarded the contract, after competitive bidding, for furnishing power for construction purposes. The company has completed the construction of a transmission line 235 miles long from Victorville, Calif., to the dam site and has also erected a substation at the terminus of the line. The contract provides for the operation of the transmission line and substation by the company for the delivery of a maximum of 15,000 kilowatts at an average price of about 1¾ cents per kilowatt-hour.

After a survey of all possible sites and with the advice of a city planning engineer, the present location of Boulder City was adopted for the headquarters of the Government and the contractor's employees during the construction period. This town, which is located about 6 miles from the dam site, is now under construction.

A railroad 10 miles in length has been located connecting the end of the railroad company's line near Boulder City with the dam site. Bids for the construction of this line were opened on January 12, 1931, and contract was awarded to the Lewis Construction Co., of Los Angeles. The railroad will be completed during the present summer and will be turned over to the main contractor for operation.

Bids were opened on January 7, 1931, for the construction of a 24-foot highway, 7 miles long, from Boulder City to the site of Hoover Dam. Contract was awarded to the General Construction Co., of Seattle, Wash., and work is now in progress and scheduled for completion this summer.

On March 4, 1931, bids were opened at Denver for the construction of Hoover Dam, power plant, and appurtenant works. The low bid of $48,890,995 was submitted by the Six Companies (Inc.), of San Francisco, and contract was awarded to this corporation. The price bid was less than $25,000 in excess of the engineer's estimate. This contract is the largest job on the Boulder Canyon project and includes the 730-foot dam, the power plant (except installation of machinery), and all appurtenant works. The period for construction will be six and one-half years, beginning April 20, 1931. The contract price does not include the furnishing of materials which enter into the completed work, such as cement, reinforcing steel, pipe and fittings, conduits, valves, gates and hoists, and structural steel. The total estimated cost of the work covered by the contract with the Six Companies (Inc.), including all materials, is about $76,000,000; and the power machinery and its installation will cost $15,000,000 additional.

Plans and specifications have been prepared and contracts awarded for numerous features in connection with the development of Boulder City. Material for the main water-supply line from the river to the city has been purchased and contract for its installation awarded. Materials have also been purchased for the filtration plant, sewage-disposal plant, and for the water distribution and sewer systems, as well as for the first group of buildings to be constructed by the Government. Work will soon be in progress on all other features required for the full development of city.

60052—31——2

Features of Interest in Connection With Work in Progress

The trip from Las Vegas to Boulder City can be made over the well-constructed branch line of the Los Angeles & Salt Lake Railroad or by automobile over an unimproved road which is now being reconstructed as a link in the Federal aid highway which will eventually connect Las Vegas with Kingman, Ariz., crossing the Colorado River on the top of Hoover Dam.

Boulder City

At Boulder City there will be evidence of much activity in the construction of buildings, and other facilities to provide comfortable quarters for the employees engaged on the 7-year construction job. The first development is being planned for a population of 2,500, but it will probably be necessary to provide for a somewhat larger population during the peak of the work. The contractor is providing commodious dormitories and mess halls for single men and numerous residences for families. The Government will provide about 75 houses for its employees, together with an administration building, dormitory and guest house, garage, auditorium, municipal building, schools, and other necessary buildings. Streets will be graded, sidewalks and curbs constructed, and an electrical-distribution system installed. The buildings to be constructed by the Government will be of an economical but reasonably substantial type of construction adapted to the climatic conditions.

Under the terms of the contract with the Six Companies (Inc.), the contractor must pay a rental of $5,000 per month for the use of the ground and the facilities provided for the contractor's organization in Boulder City. These payments, together with rentals from lots and concessions granted for various businesses, will return a considerable part of the investment of the Government in the town.

Contract is being awarded by the bureau for the paving of streets, installation of sewer and water-distribution systems, construction of sidewalks, and other civic improvements. These are all included under one contract to avoid conflict among contractors employed on work in the same area carried on concurrently.

The main pipe line for the water supply for Boulder City has just been completed by the Wheelwright Construction Co., of Ogden, Utah, and Government forces have nearly finished the installation of pumping and purification machinery and the construction of the sedimentation basin and other structures at the river intake.

The power line from the substation of the California-Nevada Power Co. to Boulder City and the pumping plants has been erected and the installations of electrical apparatus are being tested ready for immediate use. Power is available at the substation, and the Six Companies (Inc.) has considerable machinery now on the line. Payments to the power company, as outlined in its contract with the United States, have been assumed by the Six Companies (Inc.).

Advertisement has been issued for bids for the construction of the bureau administration building, hospital, dormitory, and post office. In the last-named building are included the offices for the administration of Boulder City and the police department.

Two contractors are finishing the erection of 12 small dwellings to be rented by bureau employees. They will be rented to employees during the construction period and occupied by the operating forces thereafter. Advertisement has also been issued for bids for the second group of dwellings including some of five and six rooms, and all will be rushed to completion in order that living quarters may be available as soon as it is possible to move the headquarters from Las Vegas. The Six Companies (Inc.) likewise are completing their office building, several large dormitories, and many small residences.

Applications for permits and leases for business and residence privileges in Boulder City have been received and selection of applicants best qualified will soon be completed. Active construction of private buildings will not be permitted until more of the civic improvements have been provided.

Highways

The highway from the Las Vegas connection with United States Highway No. 91 to Boulder City is now being improved by the State of Nevada and the United States Bureau of Public Roads. That portion from Boulder City to the dam site has just been opened for traffic by the Bureau of Reclamation. It was built under contract with the General Construction Co. of Seattle, Wash. This section with the branches has a total length of 8 miles and has a surfaced width of 22 feet with a 3-foot shoulder on each side. The Six

Companies (Inc.) are constructing a road joining the above to the lower portals of the Nevada tunnels at river grade. This has been difficult construction, built at the expense of the contractor and will be used for hauling excavated material from the diversion tunnel lower portals to waste bank. Included with the contract for the Hoover Dam are sections of highway on each side of the river to the top of the completed dam. Excavation of the section on the Nevada side is now being performed by the Six Companies (Inc.). In addition this contractor is constructing at its own expense a truck road for the removal of excavated material from the lower portals of the Arizona diversion tunnels to waste banks above the canyon rim in Arizona.

Railroads

The Government railroad to provide transportation from the Boulder City terminus of the Union Pacific branch to the top of the Hoover Dam is under construction by the Lewis Construction Co. and will be completed early in September, 1931. The lower portion of this line is through extremely rugged terrain, includes five tunnels and much heavy excavation. This railroad is being provided by the bureau but will be operated by the Six Companies (Inc.). This company is completing a branch from the Government railroad down Hemenway Wash to the boat landings and thence along the Nevada canyon wall to the outlets of the diversion tunnels. For a distance of nearly 2 miles in the canyon this line must be blasted from the cliff or tunneled through projecting points. The Six Companies (Inc.) have also located and are beginning the construction of a second branch to the deposit of sand and gravel in Arizona, a distance of approximately 12 miles. This line must transport 5,000,000 cubic yards of sand and gravel for use in concrete for lining the diversion tunnels and for the dam. In all, the contractor will build at its own expense approximately 20 miles of railroad, a considerable portion of which will be double track.

Diversion Tunnels

The excavation of the lower portals of the diversion tunnels is being started both on the Arizona and Nevada sides of the river. Heavy excavation in rock is encountered, and the difficulties are increased by the necessity for hauling all excavated material out of the canyon, requiring a raise in elevation of approximately 900 feet. A small adit or horizontal tunnel has been driven into the cliffs on both sides of the river midway in length of the diversion tunnels. These adits intersect the diversion tunnels near the top of the circle and will be used for the excavation of a pioneer tunnel through each of the four diversion tunnels. When completed these pioneer bores will serve to ventilate the main excavations and will show the condition of the rock as to timbering required.

Miscellaneous Features

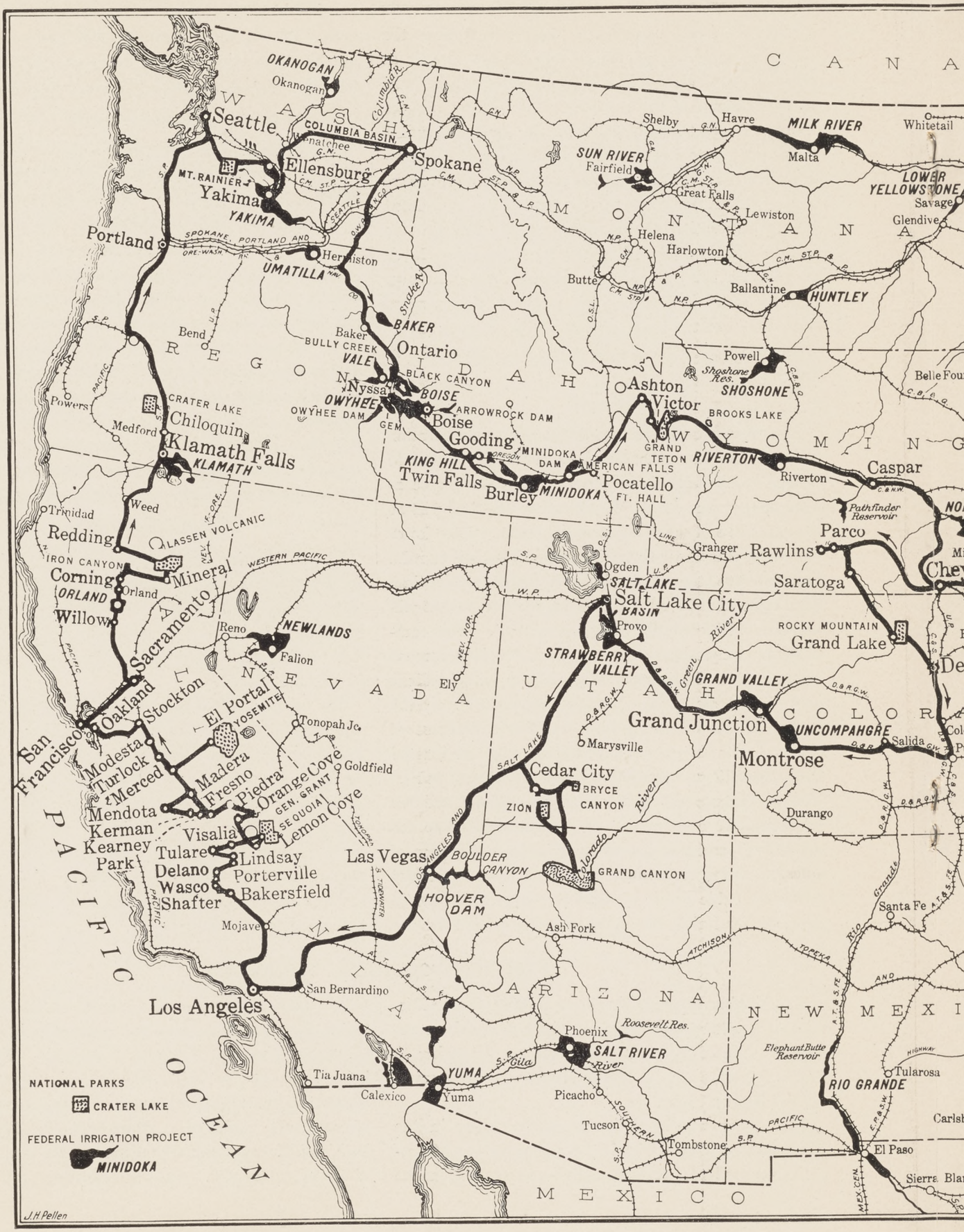
The engineering forces of the Six Companies (Inc.) are preparing designs of the gravel screening and concrete-mixing plants, the installation of equipment and machinery, the layout of cableways, and many other items which require serious consideration in a contract of such magnitude.

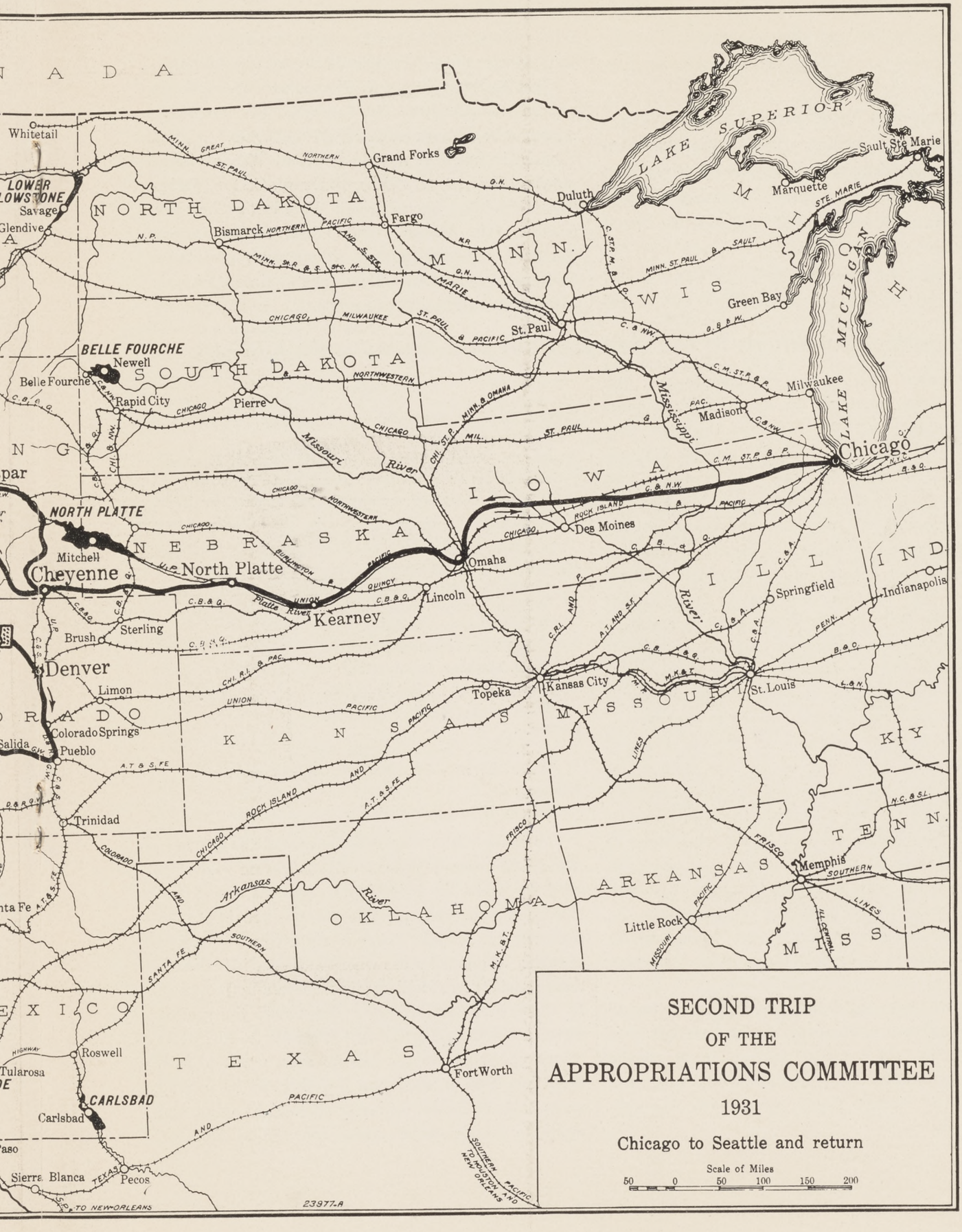
The appraisal of all reservoir lands in private ownership used for agricultural purposes has been completed. The computation of values and authority for purchase has been in progress and active negotiations with the landowners will soon be undertaken. The examination of all mining claims within the reservoir areas as to their mineral values has been nearly completed by employees of the General Land Office. It is proposed to make settlement with all owners of submerged lands well in advance of inundation.

The Metropolitan Aqueduct

Functioning through the Metropolitan Water District of southern California, 14 cities situated on the coastal plain of southern California are preparing to obtain a part of the Colorado River water conserved behind Hoover Dam.

The water will be delivered to the cities in the Metropolitan Water District by means of the Metropolitan Aqueduct. This aqueduct will have its intake at, or near, Upper Parker Canyon, about 150 miles below Hoover Dam, and the nearest point on the Colorado River to southern California. From its intake, the aqueduct will strike in a westerly direction across the mountain and desert country to the cities of southern California. Approximately 266 miles long, the Metropolitan Aqueduct will have a capacity of 1,500 second-feet. Such an aqueduct will deliver


OKANOGAN
Okanogan
Seattle
COLUMBIA BASIN
Wenatchee
Spokane
Ellensburg
MT. RAINIER
Yakima
YAKIMA
Portland
SPOKANE, PORTLAND AND SEATTLE
Hermiston
UMATILLA
Columbia R.
Snake R.
BAKER
Baker
BULLY CREEK
VALE
Ontario
Bend
Powers
CRATER LAKE
Chiloquin
Medford
Klamath Falls
KLAMATH
Trinidad
Weed
Redding
CLASSEN VOLCANIC
IRON CANYON
Corning
Orland
ORLAND
Willows
Mineral
Sacramento
Reno
NEWLANDS
Fallon
San Francisco
Oakland
Stockton
El Portal
YOSEMITE
Tonopah Jc.
Modesto
Turlock
Merced
Madera
Fresno
Piedra
Orange Cove
Goldfield
GEN. GRANT
SEQUOIA
Lemon Cove
Mendota
Kerman
Kearney Park
Visalia
Tulare
Lindsay
Porterville
Delano
Wasco
Shafter
Bakersfield
Mojave
Las Vegas
BOULDER CANYON
HOOVER DAM
Los Angeles
San Bernardino
Tia Juana
Calexico
Yuma
YUMA
Phoenix
Roosevelt Res.
SALT RIVER
Picacho
Tucson
Tombstone
El Paso
Sierra Blanca
RIO GRANDE
Elephant Butte Reservoir
Tularosa
Santa Fe
Ash Fork
Cedar City
BRYCE CANYON
ZION
GRAND CANYON
Marysville
Grand Junction
UNCOMPAHGRE
Montrose
Durango
Salida
GRAND VALLEY
STRAWBERRY VALLEY
Provo
Salt Lake City
SALT LAKE BASIN
Ogden
Granger
Rawlins
Saratoga
Parco
Pathfinder Reservoir
Riverton
RIVERTON
Caspar
GRAND TETON
Ashton
Victor
BROOKS LAKE
Powell
Shoshone Res.
SHOSHONE
Belle Fourche
Grand Lake
ROCKY MOUNTAIN
Lewiston
Helena
Harlowton
Butte
Ballantine
HUNTLEY
Great Falls
Fairfield
SUN RIVER
Shelby
Havre
MILK RIVER
Malta
Whitetail
LOWER YELLOWSTONE
Savage
Glendive
Boise
BOISE
ARROWROCK DAM
Gooding
KING HILL
Twin Falls
Burley
MINIDOKA
MINIDOKA DAM
AMERICAN FALLS
Pocatello
FT. HALL
OWYHEE
OWYHEE DAM
BLACK CANYON
NEVADA
UTAH
COLORADO
ARIZONA
NEW MEXICO
MEXICO
PACIFIC OCEAN
NATIONAL PARKS
CRATER LAKE
FEDERAL IRRIGATION PROJECT
MINIDOKA
J.H.Pellen


SECOND TRIP
OF THE
APPROPRIATIONS COMMITTEE
1931
Chicago to Seattle and return
Scale of Miles
50 0 50 100 150 200
23977-A
Whitetail
Savage
Glendive
Grand Forks
Duluth
Sault Ste Marie
Marquette
Bismarck
Fargo
Green Bay
St. Paul
Milwaukee
Madison
Chicago
Belle Fourche
Newell
Rapid City
Pierre
Des Moines
Omaha
Lincoln
Kearney
North Platte
Cheyenne
Mitchell
Sterling
Brush
Denver
Limon
Colorado Springs
Pueblo
Trinidad
Roswell
Carlsbad
Sierra Blanca
Pecos
Fort Worth
Little Rock
Memphis
Springfield
Indianapolis
St. Louis
Kansas City
Topeka
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
IOWA
MINN.
WIS.
ILL.
MISSOURI
ARKANSAS
LAKE SUPERIOR
LAKE MICHIGAN
Missouri River
Arkansas River
Platte River

approximately 900,000 acre-feet of water to the cities in the Metropolitan Water District after allowance has been made for losses.

The Metropolitan Water District will finance, build, and operate the aqueduct. The district has contracted with the Federal Government for 36 per cent of the hydroelectric power output of Hoover Dam to pump the water over a series of lifts along the line of the aqueduct.

Hoover Dam will store and desilt the water needed to fill the Metropolitan Aqueduct, and will be the source of the hydroelectric energy required to raise the water at the several aqueduct pumping plants.

Chief Engineer Frank E. Weymouth, of the Metropolitan Water District, has estimated the cost of the aqueduct to be approximately $200,000,000.

Cities included in the Metropolitan Water District are Anaheim, Beverly Hills, Burbank, Colton, Fullerton, Glendale, Long Beach, Pasadena, San Bernardino, San Marino, Santa Ana, Santa Monica, Torrance, and Los Angeles. Other cities in southern California are expected, from time to time, to join in carrying out this great enterprise.

Irrigation Conditions in the San Joaquin and Sacramento Valleys

The irrigated area in the Sacramento and San Joaquin Valleys, including the delta lands, amounts to approximately 3,000,000 acres and the citrus crop alone in 1930 was valued at $17,339,000 and the grape crop at $27,648,000. Early in the present year a delegation from California waited upon Mr. Murphy, of the Appropriations Committee, and asked that the visit of the committee include a study of irrigation conditions in San Joaquin and Sacramento Valleys. The reason for this request is that in an important section of the San Joaquin Valley there is a serious and growing shortage of water for irrigation of orchards and vineyards and for domestic use in towns, while in the Sacramento Valley there is a large surplus of water which each year escapes unused to the sea.

This difference in conditions in different parts of this great valley grows out of the fact that irrigation development has been carried out almost entirely by districts and private enterprise, the work done in one locality having no relation to the work done in another. It has been independent and uncoordinated. Now the State has come to realize the necessity for comprehensive planning under which the surplus water of one section of the valley can be used to supplement and relieve the shortage in another section.

In 1929 the State legislature passed a law to create a water-resources commission. Later, arrangements were made by which three representatives of the Federal Government were appointed and what was known as the Hoover-Young Commission was constituted as follows:

United States Members

Elwood Mead, Commissioner of Reclamation, United States Department of Interior.

Thomas M. Robins, lieutenant colonel, Corps of Engineers, United States Army, division engineer, south Pacific division.

F. E. Bonner, executive secretary Federal Power Commission.

California Members

Designated by the governor:

George C. Pardee, chairman, Oakland.
William Durbrow, Grass Valley.
B. A. Etcheverry, Berkeley.
Alfred Harrell, Bakersfield.
W. B. Mathews, Los Angeles.
Warren Olney, jr., San Francisco.
Frank E. Weymouth, Los Angeles.

Ex-officio:

B. B. Meek, director of public works.
W. J. Carr, member of the State railroad commission

Secretary:

Edward Hyatt, state engineer.

The route of the congressional committee has been planned in order to traverse both the areas where the need for water in irrigation is greatest and where storage on the largest scale can be provided. In southern San Joaquin Valley it will traverse a number of highly developed areas where water for irrigation is drawn mainly from underground sources by pumping. In the area northward from Bakersfield the ground water table has been lowered from 30 to 40 feet in recent years, and in the Delano area, north of this, there has been a maximum lowering of the ground water table of 70 feet during the past eight years, and depth to ground water ranges from 50 to 250 feet.

Most of the loaning agencies have withdrawn from this latter area because it has been demonstrated that the underground supply is being steadily exhausted.

Lindsay is in the heart of one of the finest citrus areas in California. Irrigation is dependent on underground waters which have to be pumped. The water plane has been lowered until in places the lift is now 250 feet, and there is a tendency to increase the salt content with the deeper lifts.

The Foothill irrigation district, which includes 50,000 acres, has 11,000 acres planted to citrus and deciduous trees and vines. Here an almost hopeless situation has been created by lack of water.

The San Joaquin River emerges from the foothills near Friant, where a high dam is proposed to store and divert the entire flow of the river to irrigate lands in the southern San Joaquin Valley, exchanging Sacramento water therefor at Mendota.

The Madera district comprises 179,000 acres of which 80,000 are irrigated by pumping from 1,700 wells. The water table is dropping steadily and the available inflow is inadequate for its replenishment.

The Merced district has a gross area of 189,682 acres. Upon its organization in 1919 it embarked on a construction program involving the building of Exchequer Dam and power plant, the extension and improvement of the distribution system and the completion of the drainage system, the total investment amounting to more than $16,000,000.

Exchequer Dam is an arched gravity structure on the Merced River, 326 feet high and with a crest length of 950 feet. All the power generated is sold to the San Joaquin Light & Power Co. under long-time contracts.

The Modesto and Turlock districts are provided with an irrigation supply from the jointly owned Don Pedro Storage Dam and La Grange Diversion Dam on the Tuolumne River. The jointly owned power house at Don Pedro Dam has an installed capacity of 30,000 kilowatts, and the Turlock district has built a 4,000-kilowatt plant below La Grange Dam. The districts distribute the power, and as a result of the power development receive their irrigation water without cost.

The Salt Water Problem

Ten miles south of Stockton the San Joaquin River reaches tidewater. Northward nearly to Sacramento and westward to Antioch and Collinsville lies an area of 400,000 acres of flat swamp land of unsurpassed fertility, through which the waters of the Sacramento and the San Joaquin find their way to a common mouth at the head of Suisun Bay. These delta channels form part of the tidal basin of San Francisco Bay, the pulsating effect of the tides tending to push upstream into the upper bay and delta channels the salty waters of the lower bay and the ocean. The lowered rainfall and lessened flow of the San Joaquin and Sacramento Rivers during the past 13 years have aggravated this situation.

To end this danger from salt water the construction of a dam or salt-water barrier has been proposed. Detailed plans and estimates for possible dams have been made by the Bureau of Reclamation in cooperation with the State of California, but no action has been taken because of the large cost. Another plan for preventing the rise upstream of salt water has been to hold it back by means of increasing the volume of fresh water in the drier months of the year. This would be done by building upstream storages and releasing the water to augment the stored water whenever this was needed. A flow in the two rivers of not less than 3,300 second-feet past Antioch into Suisun Bay would be necessary.

The Yolo causeway near Sacramento is a 3-mile concrete structure over the Yolo by-pass, a flood-relief channel into which the waters of the Sacramento are turned to relieve the main channel in times of flood. The cost of the causeway and by-pass was several million dollars.

The Glenn-Colusa district has a gross area of 125,000 acres and draws its irrigation supply from the Sacramento River by means of a low-head pumping plant.

West of Maxwell is the Mills orchard, said to be the largest lemon grove under one ownerhsip in the world. It is irrigated by pumping from the Glenn-Colusa Canal.

Investigations of the Bureau in 1930

As an emergency or relief measure for the water shortage of the past 10 years and to provide an additional water supply for those areas where the underground waters are inadequate, the Bureau of Reclamation in 1930 made a study of these conditions and worked out what seems to be a feasible project involving the construction of a storage dam on the San Joaquin River at Friant and another storage on Kings River at Pine Flat, the waters thus conserved to be carried in canals to the nearest areas where the shortage of water and losses arising therefrom are most acute. The water to fill these storages would be surplus flood flow and a part of the normal flow of the San Joaquin River, now used to irrigate pasture land or so-called grass lands which could be purchased and their water rights help to fill the reservoir and enable the water to be put to a more profitable use. The cost of the project has been roughly estimated at $25,000,000, and the time of construction two years.

There would also be a power development, and returns from the sale of electrical energy, together with a reasonable charge for the stored water, would, it is believed, repay the cost with interest at 4 per cent within a 40-year period. The Bureau of Reclamation was brought into these studies because of the desire on the part of the State to avail itself of the bureau's experience in widely separated areas and because, being an entirely disinterested party, it could exert an influence as a mediator in reconciling conflicting interests and in working out a program without injuring anyone, which would conserve water that now runs to waste, apply some water now used to a higher and more profitable use, and thereby continue the development and save the lovely gardens and homes that without such aid might have to be abandoned.

Orland Project, California

Water for irrigation of the Orland project is furnished by Stony Creek, but it is a widely fluctuating supply and dependence has to be almost entirely on storage. This is provided by two dams (East Park and Stony Gorge) placed in the channel of the stream, one about 16 miles below the other. Each dam creates a reservoir of about 50,000 acre-feet capacity.

Alfalfa and dairying are the leading agricultural lines, but orchards of nuts, citrus and deciduous fruits are being planted and are rapidly growing in importance. Orange, grapefruit, and lemon groves are being grown where a few years ago this was regarded as impossible. That Orland is in the citrus thermal belt was demonstrated during the severe frosts of 1913, 1922, and 1924, which left the Orland groves unharmed. Prunes, figs, peaches, apricots, pears, grapes, olives, watermelons, and many varieties of berries are included among the fruits grown on the project. Almonds in full bearing produce 1,500 pounds of nuts per acre, and oranges as high as 300 boxes per acre. Last year the cultivated area of 12,454 acres produced crops valued at $578,706. Excellent rail and highway facilities are available. All land in the project is in private ownership. Unimproved land may be purchased for $75 to $160 per acre and improved property for $200 to $1,000 per acre.

The Larger Storage Project of California

For several years the Bureau of Reclamation and the State of California have been carrying on extensive studies to determine how the flood waters of both the Sacramento and San Joaquin Rivers can be conserved. Among the principal sites investigated are the Iron Canyon and Kennett Dam sites. Tentative plans call for construction of a 170-foot dam at Iron Canyon with a reservoir capacity of 1,123,000 acre-feet, at an estimated cost, including the power plant, of $20,000,000, and for a 420-foot dam near Kennett with a reservoir capacity of 2,940,000 acre-feet, at an estimated cost of $84,000,000, including highway and railroad relocation and power development.

Klamath Project, Oregon-California

Klamath Falls, Oreg., where the committee will stay overnight before motoring to Crater Lake National Park, is the headquarters of the superintendent of the Klamath Federal irrigation project and his force. The project is located in Klamath County, Oreg., and in Modoc and Siskiyou Counties, Calif.

STONY GORGE STORAGE DAM, 142½ FEET HIGH, ORLAND PROJECT, CALIFORNIA. (SEE P. 16.)

The present irrigable area comprises 55,385 acres. The average annual rainfall is 12.65 inches, with about 3½ inches falling during the growing season. The elevation of the project is about 4,100 feet above sea level. The water supply, which is ample, is obtained mainly from Upper Klamath Lake supplemented by water from Lost River. Transportation facilities are excellent, both by rail and highway. One of the interesting developments here is the settlement of the old bed of Tule Lake as rapidly as evaporation permits. These farm units are eagerly sought for whenever an opening occurs, the number of qualified applicants being always far greater than the number of available farm units. The land in the lake bed is very smooth, necessitating little preliminary work of clearing and leveling prior to cultivation. The main crops on the project are alfalfa and the grains. Potatoes and root crops do well. Sugar beets have been grown successfully experimentally. Last year the irrigated area of 45,781 acres produced crops valued at $1,727,147. The project is particularly adapted to diversified farming and stock raising.

Yakima Project, Washington

The first reclamation project to be visited after the return of the committee from Alaska is the Kittitas division of the Yakima project. The estimated cost of this division is $9,088,300 and the amount already expended $7,912,580. The irrigation plan provides for a storage dam at Cle Elum with a reservoir holding 500,000 acre-feet and below this the diversion at Easton Dam, 40 miles above Ellensburg. The main canal is one of the most difficult pieces of irrigation construction ever undertaken in this country. It traverses the precipitous slopes of the Yakima River Canyon for 26 miles, when the canal divides, the North Branch passing under the Yakima River through a concrete lined tunnel 9 feet 3 inches in diameter with a maximum pressure head of 500 feet. About half the length of the main canal is lined with reinforced concrete. Costly and difficult as this construction has been, its benefits are commensurate. A developed community which for years struggled with an inadequate water supply has been saved from ruin and made a part of the successful economic development of eastern Washington.

Below the developing Kittitas district are the older and more fully developed districts around Tieton, where 113,155 acres produced crops last year worth $8,087,025, or $71.47 per acre.

Columbia Basin Project, Washington

Numerous investigations of the Columbia Basin project have been made by various agencies, private, State, and Federal. All are in agreement that eventually the project will be constructed, as it offers an opportunity for development second only to the Boulder Canyon project. At present, investigations are being carried on by the Bureau of Reclamation and the War Department.

The project comprises a triangularly shaped tract of land in the southeastern part of the State of Washington, lying between the Snake and the Columbia Rivers, with its most southerly point at Pasco, Wash., where the two rivers meet. The estimates of its irrigable area vary from 1,086,819 to 1,883,000 acres. About 90 per cent of the area is owned by people in widely scattered parts of the United States. Individual holdings range from a few acres to several sections. Owing to the lack of irrigation, much of the land once dry farmed has gone back to sage brush. About one-third of the project area is still being cultivated to wheat in large tracts largely under a system of tenant farming.

In 1925 the engineering report on the project by Homer Gault, engineer in the Bureau of Reclamation, was reviewed by a board of six eminent construction engineers who considered five different plans of development. In the same year their report was reviewed by the Columbia Basin commission, comprising Dr. Elwood Mead, Commissioner of Reclamation, and Hon. John H. Edwards, Assistant Secretary of the Interior. This commission favored the plan which embraced the development of 1,224,000 acres, which, with the exception of 170,000 acres of pumping lands, would be irrigated by gravity, using the waters of the Pend Oreille and Spokane Rivers. The construction cost was estimated at $193,300,000 or $158 per acre. Further investigations were, however, deemed necessary, the commission stating that it had "no doubt that the time will come when local and national interests will require the construction of these works and

MORRISON CANYON SIPHON ON THE MAIN CANAL, KITTITAS DIVISION, YAKIMA PROJECT, WASHINGTON. THE SIPHON HAS A DIAMETER OF 12 FEET 1 INCH AND A CARRYING CAPACITY OF 1,145 SECOND-FEET. (SEE P. 18)

the utilization of these immeasurably valuable resources."

The results of the investigations now in progress and the experience gained in the construction, settlement, and development of the Boulder Canyon project may well point the way to the eventual construction of the Columbia Basin project.

Owyhee Project, Oregon-Idaho

The Owyhee project is the costliest project undertaken by the Bureau of Reclamation with money supplied from the reclamation fund. Its plans include the dam, which will be 520 feet in height from the lowest part of the foundation to the top and two tunnels, one 3.55 miles long and 16 feet 7 inches in diameter, and the other 4.15 miles long and 9 feet 3 inches in diameter. To build the dam, tunnels, and main canal will cost $18,000,000, of which $5,113,063 has already been expended. The dam creates a reservoir with a capacity of 715,000 acre-feet, which will supplement water taken from the natural flow of the river. The area to be irrigated is 122,000 acres, of which 64,000 acres are in sage brush at present and 58,000 acres in districts highly improved but which lack an adequate water supply or are compelled to pay high pumping charges.

Vale Project, Oregon

The estimated cost of the Vale project is $4,053,000 and there has been expended on its construction $3,201,999. The project which lies in Malheur County, Oreg., is being constructed to provide for the irrigation of land which has been settled and partly improved for many years. For the irrigation of this land the Federal Government has purchased storage in Warmsprings Reservoir, which was constructed privately by the Warmsprings irrigation district. Additional storage will be necessary and plans for this are being made. This is one of the costly projects under construction by the bureau, but its construction is fully justified because of the excellent character of the land to be irrigated and the fact that it is in a developed community. The irrigable area is about 25,000 acres. Last year works were completed for the irrigation of about 4,000 acres; 7,700 acres are being irrigated this year; and it is expected that by the season of 1932 water will be available for about 14,700 acres. These lands are mostly in private ownership and are being sold to settlers at prices fixed by the appraisal board for "raw lands" without reference to their speculative value as a result of the irrigation development. All lands are being disposed of to a high class of settlers as rapidly as water becomes available.

Gem Irrigation District

Leaving the Vale project by auto the committee will motor to Boise by way of the Gem and Black Canyon irrigation districts. The Gem district is part of the Owyhee project. The gross area comprises about 26,800 acres below existing canals, and about 24,000 acres above such canals which will be susceptible of irrigation from canals of the Owyhee project when completed. Water for irrigation is pumped from Snake River with an average lift of 120 feet. Until 1924 power for pumping was obtained from the Idaho Power Co., but since then the main portion has been obtained from the Black Canyon power plant of the Bureau of Reclamation at a greatly reduced cost. The contract between the district and the United States, which provides for furnishing water from the Owyhee Reservoir now under construction, will result in a further reduction in operation costs. The local management is very efficient, and under it charges have been reduced, seeped lands reclaimed out of current revenues, and general improvements have taken place in the condition of the district and the farmers.

Black Canyon Irrigation District

The proposed Black Canyon project, which the committee will next pass through, includes 47,000 acres of lands in the Payette division of the Boise project. About 15,000 acres are public land. The land is located in southwestern Idaho between the Boise and Payette Rivers, extending to the Snake

River on the west. Water for the irrigation of this land would be stored in Deadwood Reservoir, recently constructed on the Deadwood River, a tributary of the Payette, and diverted at the Black Canyon Dam, which was completed in 1924 and from which water is now supplied to the Emmett irrigation district. Thirty miles of canal would conduct water from the diversion dam to the lands. About two-fifths of the area would be covered by pumping lifts from the main canal, the maximum lift being 100 feet. Two pumping plants would be operated by electric power from the plant installed at the Black Canyon Dam. A contract has been entered into between the United States and the Black Canyon irrigation district providing for a maximum expenditure by the bureau of $8,160,000 to construct the needed irrigation works. Funds have not been made available for construction of the canals, laterals, and other works.

The altitude varies from 2,200 to 2,500 feet above sea level, and the average annual precipitation is about 10 inches. The principal crops that could be grown under irrigation include the grains, alfalfa, clover, corn, potatoes, onions, apples, and prunes. If the project is constructed, it will require from 600 to 700 settlers.

Boise Project, Idaho

The Boise project, portions of which the committee has been passing through, is located in southwestern Idaho and eastern Oregon in the Boise and Snake River Valleys. The project comprises 170,575 acres of irrigable land and in addition 139,600 acres adjacent to the project are served with project water under Warren Act contracts. The lands lie about 2,500 feet above sea level, and the annual precipitation averages 13.6 inches. Water for irrigation is obtained from the Boise River, the irrigation plan including the 349-foot Arrowrock Dam, until recent years the highest dam in the world; the Deer Flat Reservoir; the Boise Diversion Dam; and a complete canal, lateral and drainage system. The cost of the project is $15,975,000. Water users have repaid on construction $3,747,000. The land is all in private ownership. The soil and climate are favorable for the growth of practically all temperature zone crops. The principal crops include alfalfa, the grains, potatoes, lettuce, truck crops, apples, prunes, apricots, grapes, pears, peaches, and cherries. Last year the 154,059 acres of cultivated land on the project produced crops valued at $4,057,819. The project is adequately supplied with transportation facilities.

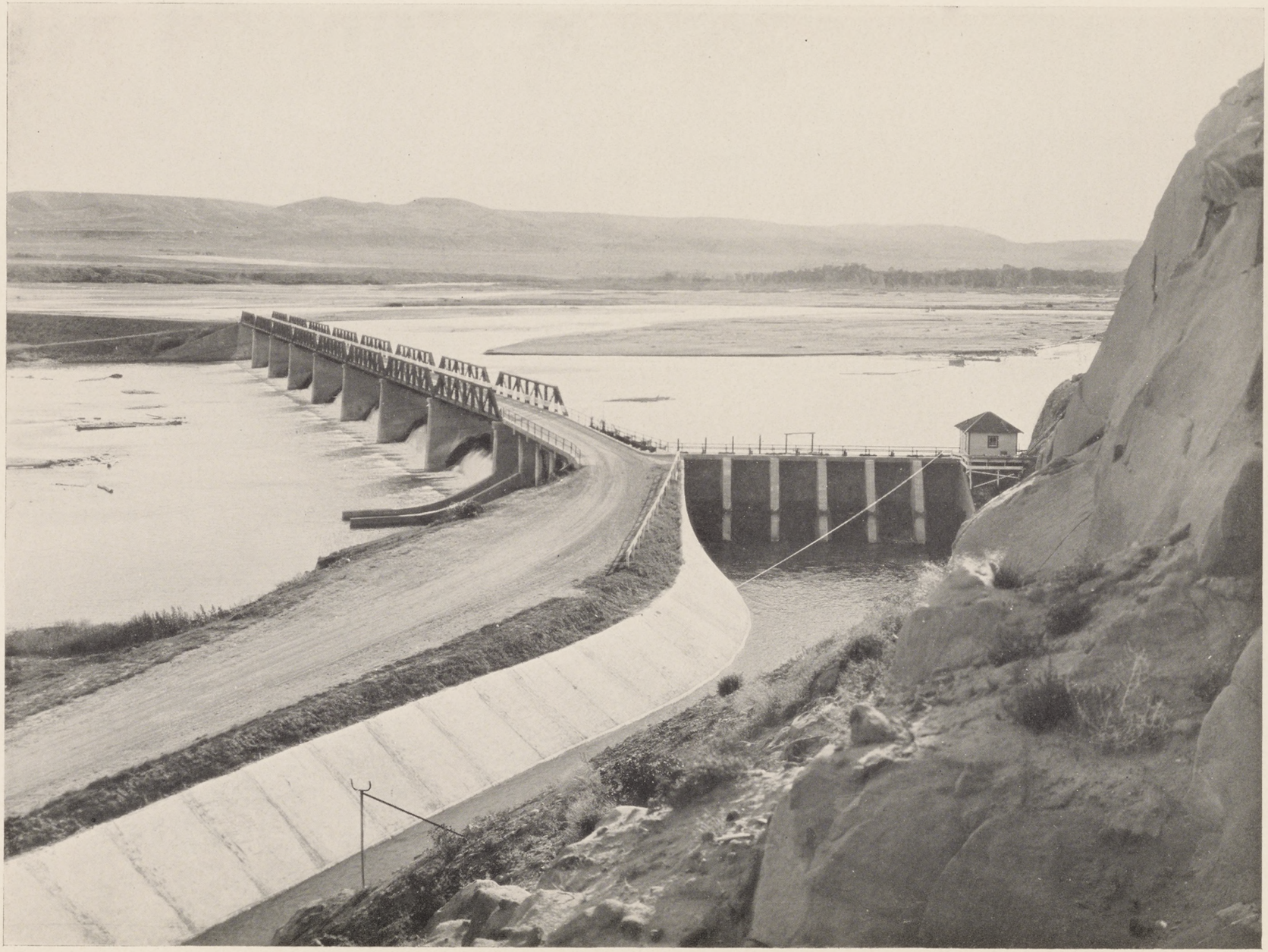
The Arrowrock Dam, which the committee will visit, is a rubble concrete arch, 349 feet high, and with a crest length of 1,100 feet. The area of the reservoir is 2,860 acres with a capacity of 280,000 acre-feet.

Gooding Division, Minidoka Project, Idaho

This is an example of the work the Bureau of Reclamation is doing in furnishing an adequate water supply to a developed area which has been struggling to maintain itself with an inadequate supply. The project was constructed under the Carey Act 20 years ago, obtaining its water supply from Big Wood and Little Wood Rivers. The canal being constructed by the Bureau of Reclamation will divert water from Snake River at Milner Dam, 25 miles east of Twin Falls, Idaho, and run northwesterly for 70 miles to an intersection with the old canal serving these lands, comprising some 60,000 acres. In addition there are 20,000 acres of public land which might also be irrigated from the new canal. However, as yet no provision has been made for the construction of the necessary laterals to serve this public land.

All lands to be benefited by this construction have been organized into the American Falls Reservoir District No. 2, and a contract has been entered into providing for the repayment to the Government of a maximum of $7,500,000.

The prevailing crops are alfalfa, sugar, beets, corn, and grain.



WIND RIVER DIVERSION DAM, RIVERTON PROJECT, WYOMING. (SEE P. 23)

Minidoka Project, Idaho

The Minidoka project, comprising an irrigable area of 120,000 acres, is located in Minidoka and Cassia Counties in southern Idaho. Water for irrigation is obtained from the natural flow of Snake River supplemented by ample provision for storage in Lake Walcott near Minidoka, Idaho; in Jackson Lake near the Yellowstone Park in Wyoming; and at American Falls Reservoir, about 60 miles above the diversion points. The land lies at an elevation of about 4,200 feet above sea level, and the average annual precipitation is 11½ inches. The project is in two main divisions. The area north of Snake River, comprising 64,000 acres, and 7,000 acres south of the river are operated by the Minidoka irrigation district and are largely watered by gravity. South of the river are 49,000 acres operated by the Burley irrigation district and watered by electrically operated pumps with lifts of 30, 60, and 90 feet.

In connection with the irrigation system the bureau has constructed a power plant of 13,500 horsepower capacity, which supplies power for irrigation pumping and for domestic purposes. All of the towns on the project are supplied with electricity from this source and about 75 per cent of the farms. This feature, together with adequate transportation facilities, both rail and highway, adds greatly to the comfort and convenience of rural life.

The principal crops are alfalfa, grain, potatoes, and sugar beets. Dairying is an established industry. Last year the cultivated area of 99,990 acres produced crops valued at $3,206,284.

The construction of American Falls Dam on the Snake River, which the committee will visit, made possible the furnishing of additional water for large areas of land in the valley previously dependent upon the unregulated flow of the river.

Riverton Project, Wyoming

The Riverton project is built to utilize the waters of Wind River. It includes one storage reservoir, Pilot Butte, with a capacity of 30,000 acre-feet, and the plans embrace the improvement of Bull Lake, a natural storage with a capacity of 145,000 acre-feet. The project has an ultimate irrigable area of 100,000 acres. Canals and laterals have been built for 35,000 acres. Development is slow largely because of lack of transportation facilities and a beet-sugar factory. On May 1 the bureau opened to entry 50 farm units in the Pilot division of the project, comprising land lying nearest to Riverton and probably the best land on the project. It is expected that, with the cooperation of the State and other agencies, these lands will be settled promptly. Last year 1,105 acres were cultivated, producing crops valued at $10,308.

Casper-Alcova Project, Wyoming

The proposed Casper-Alcova project is located in central Wyoming near the city of Casper. The irrigable area comprises 66,000 acres. Elevations range from 5,150 feet to 5,475 feet above sea level. The yearly precipitation averages 14.66 inches, and the frost-free period is about 130 days. The lands have been classified. Practically all the lands are in private ownership, with an average holding of 350 acres of irrigable land.

The irrigation plan includes the construction of an earth and rock-fill diversion dam across the North Platte River in Alcova Canyon, about 10 miles below Pathfinder Dam and 32 miles above Casper, Wyo.

Local conditions favor two main types of farming. The first would be built around sugar beets as the main crop, supplemented with alfalfa, peas, barley, and oats. About one-fourth of the area, not suited to sugar beets, would be devoted to general dairy farms, with potatoes the main crop.

It is estimated that the maximum assessment these lands will stand for irrigation water will be $4 per acre for first-class land and $3.25 per acre for second-class land, with a project average of $3.50. With operation and maintenance at $1.50, there is left $2 per acre to be applied on the annual construction payments.

The cost of the project is estimated at $15,861,235. Some of the advantages of the project are—

1. Location near second largest city in Wyoming.
2. Excellent local market.
3. Healthful climate.
4. Good highway and railroad facilities.
5. Provides winter feed for an extensive grazing area.

Memoranda

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